Sugar Research and Development Corporation

Final Report

Project Title: **Sugarcane smut variety screening in the Ord.**

Project Number: **WAA002**

Research Organization: **Agriculture Western Australia**

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Project Summary

A sugarcane smut screening trial was initiated in the Ord with planting in September 1999. Eighty-four cane varieties were rated for sugarcane smut susceptibility. Varieties included those introduced through SRDC project CTA043 and other commercial lines introduced previously. Setts were inoculated with smut spores prior to planting and varieties rated for smut susceptibility at 8, 15 and 31 weeks from planting. The trial area was ratooned on 12 May 2000. The ratoon crop was rated at 8 and 16 weeks with final rating planned for October/November 2000.

A number of findings from the trial will assist with future screening and contribute to more efficient and successful management of the disease. It was found that:

- Early inspection, at 8 weeks from planting, identified only some susceptible varieties with only a small number displaying visual symptoms at this stage.
- Results from later inspections of the plant crop generally closely followed commercial field results. Canes with resistance in the field, such as Q95, were also found to be highly resistant in the trial. Varieties Q117 and NCo310 were highly susceptible in both field and trial situations. Q96 however showed more susceptibility in the trial than expected from field results. This is likely to be partly due to higher spore levels and spore pressure in the trial area.
- Early screening of the ratoon crop generally showed similarities in smut ratings to the plant crop but with some exceptions. Varieties with higher levels of infection in the plant crop generally expressed symptoms earlier in the ratoon crop.
- Analysis of results indicates that most of the variation amongst means of clone replicates in the trial is due to genetic variation rather than experimental error and that there would be little loss in ability to discriminate amongst clones by having only 3 replicates instead of 4.
- Correlation between ratings (percentage of stools infected) and extent of infection in each plot (estimate of total whips) was generally high. Hence ratings are likely to be a good indicator of impact of smut on crop performance.

Tentative ratings of the plant crop have identified 17 varieties including Q95, Q99, Q130, Q142, and Q155 as highly resistant to sugarcane smut. Further testing will be required to confirm these findings and to identify other varieties assessed that might also be adequately resistant. This will partly be achieved through screening of the ratoon crop.

Comparison was made between results from the Ord and smut trials undertaken in Indonesia by the BSES. Preliminary indications are that Indonesian data can be used to successfully predict smut reactions in the Ord, although further testing would be required to confirm this.

A significant number of varieties screened were found to be smut susceptible. Future access to sources of predominantly smut resistant varieties will be required to ensure

adequate numbers of varieties are available for assessment for commercial production in the Ord.

Trial results have been distributed to Ord growers, the BSES and the CSIRO for use by the Australian industry and have been adopted for use by the Ord industry. Results have been used to eliminate smut susceptible varieties from further assessment in variety trials. Inclusion of varieties that could become heavily infected in these trials could potentially affect trial results by inducing low levels of infection in resistant varieties.

Background

Sugar cane smut (*Ustilago scitaminea*), a significant disease of sugar cane throughout the world was first identified in the Ord in July 1998. This was also the first outbreak within Australia. The disease was previously found in most sugar cane growing areas throughout the world and was known to cause serious crop loss in highly susceptible varieties under conditions conducive to its development. An important control measure for smut is the use of resistant varieties (Hoy, 1993).

In 1998 there was only minimal information on susceptibility of cane varieties grown in Australia and under Australian conditions. Two of the five main commercial varieties grown in the Ord at that time were found to be highly susceptible (NCo310 and Q117). It was necessary to remove these and to replace them with resistant varieties grown commercially at the time. To ensure that additional, suitable varieties would be rapidly identified for commercial production in the Ord and to assist in providing information for the Australian industry, a project was initiated to screen all sugar cane varieties present in the Ord.

Smut screening was also commenced in Indonesia by the BSES (Croft et al, 2000). Additional work was required in the Ord as most of the Ord varieties could not be screened in Indonesia at that time. Results from varieties assessed at both locations were compared through the project to determine if similar results could be obtained at each site, to potentially allow future work to be conducted at one site only.

The Ord sugar industry has supported this project and its development in consultation with Dr Brian Egan, CSIRO and the BSES.

Objectives

The objective of the project was to screen sugarcane varieties introduced to the Ord, for resistance to sugar cane smut. Varieties screened include those introduced through SRDC project CTA043 and other commercial lines introduced previously.

This objective has been fully achieved.

Methodology

Spore collection and testing:
Three thousand smut whips were collected and air dried and the spores sieved. Whips were collected by cutting the whip from the plant. The entire whip was then dried before the brittle material was crushed to release the spores. A small spore sample was sent to Perth (Agriculture Western Australia laboratories) for spore count and viability assessment. The remainder (350g) was stored in an air-tight container (Sample A). Spore testing indicated that additional spores would be required. An additional 700 whips were collected for drying and sieving. A small sample was sent to Perth for spore count and viability assessment and the remainder (80g) stored in an air tight container (Sample B).

Results of spore testing:

Sample	Weight (g)	Assessment date	Count (spores/g)	Germination @ 28°C (%)
A	350	7 July 1999	2×10^9	73
B	80	25 August 1999	2×10^9	63-71

Inoculation and planting:

Spore Samples A and B were mixed and used to inoculate setts used for planting in the trial. The trial was planted on 1 September 1999 in Cununurra clay on bay 10E at the Frank Wise Institute at Kununurra.

A randomized complete block design was used with 84 varieties and 4 replicated plots for each variety. Plots were a single 5m row planted with 10 setts, each sett with 2 eyes.

Varieties used are listed in Appendix 1.

Setts of each variety were cut from propagation plots and placed in onion bags before dipping in a tank containing 100L of a solution of 5×10^6 viable spores/ml. Setts were dipped for 10 minutes, drained and left in a cool place overnight before planting the following day.

Setts were hand planted into furrows in pre-irrigated ground in the centre of 1.8m beds and covered with approximately 2 cm of soil. The trial area was furrow irrigated immediately after planting and at sufficient intervals to prevent water stress until dry down prior to harvest. The area was fertilized with 250 kg DAP following planting and ridged up prior to canopy closure.

Inoculation and planting were under the supervision of consulting pathologist Dr Brian Egan.

The trial area was ratooned on 12 May 2000 to allow rating of the first ratoon crop. The area was again fertilized with 250 kg of DAP and ridged up prior to canopy closure.

Smut rating:
Smut ratings were carried out on 27 October and 13 December 1999 and 3 April 2000 for the plant crop and on 11 July and 6 September 2000 for the first ratoon crop. A final rating is planned for the ratoon crop in October/November 2000. Consulting pathologist Dr. Brian Egan was present at the December and April ratings.

At rating, total stool number and number of infected stools were recorded for each plot. Infected stools were those with at least one smut whip visible or with grassy shoots. The extent to which each plot was infected was also recorded by estimating the number of whips per plot and then ranking each as having few, some, many or very many whips.

Analysis of results:
Plant crop trial results were analyzed for the final rating using analysis of variance to determine variation in infection rates due to genotypes.

Phenotypic and genotypic correlation coefficients were calculated between the final Ord plant cane data and the Indonesian plant and ratoon cane data. Correlations were determined without Q125 results as the variety listed as Q125 provided different results in the Indonesian and Ord trials and it is possible that different varieties were used at each site. This is currently under further investigation. Indonesian results were provided by the BSES for a trial undertaken during 1999.

Coefficients were determined for each assessment in the Ord for correlation between percentage of infected stools and extent of infection of each plot.

A report on the plant trial results was prepared for presentation to the Ord industry and for circulation for use by the Australian industry.

Results

Smut rating results are presented in Appendix 1. Results are expressed as a percentage of stools infected.

Appearance of smut whips and grassy shoots increased with crop age and occurred more rapidly for the ratoon crop. At the preliminary inspection on 27 October 1999, only a small number of varieties displayed visual symptoms of smut infection (whips or grassy shoots). Maximum rate of infection was 19 percent for the variety 89-338-1 with only 18 percent of varieties showing any infection. A total of only 29 infected stools was identified at this inspection.

At the second inspection in December, maximum rate of infection increased to 82 percent (Tellus) with 77 percent of varieties showing infection. The number of infected stools had increased significantly since the first inspection in October with 466 infected stools found, or 16 percent of total stools. Overall percentage of infection in each of the four replicates was reasonably consistent at between 14 and 17 per cent.

At the final plant crop inspection at 31 weeks from planting, 85 percent of varieties showed infection with 15 percent having all stools infected.

In the ratoon crop, at 16 weeks from ratooning, 81 percent of varieties showed infection and 18 percent had all stools infected. Final assessment results will not be available for the ratoon crop until October/November 2000.

Correlation between percentage of infected stools and extent of plot infection:
The extent of infection in each plot was highly correlated with the percentage infection rating, at all assessments (Table 1), indicating that where more stools are infected it is also likely that those stools will be more heavily infected. Hence percentage infection of stools is likely to be a good indicator of extent of infection and impact of smut on crop performance.

Table 1. Coefficients of correlation for percentage smut infection versus extent of plot infection.

	Coefficient of Correlation
Plant Crop	
27 October 1999	0.92
13 December 1999	0.80
3 April 2000	0.88
Ratoon 1 Crop	
11 July 2000	0.86
6 September 2000	0.89

Analysis of variance:
Analysis of variance for the final plant crop assessment showed highly significant ($P<0.01$) variation in percentage stool infection due to genotypes. The genotypic variance component was 1260 compared with an error variance component of 429. Least significant differences ($P<0.05$) for percent infection were relatively high at 29% (4 reps), 33% (3 reps), 41% (2 reps) and 59%(1 rep). Heritability for 4 replicates was 0.92 and was only reduced to 0.89 for 3 replicates. This indicates that most of the variation amongst clone means is due to genetic variation rather than experimental error.

Tentative ratings based on plant crop results:
Twenty-two varieties which appear to be resistant, with less than 15 percent infection, include H51-8194, H73-6110, MQ80-805, MQ88-2022, MQ88-2047, Q95, Q99, Q125, Q130, Q142 and Q155. Since Q125 showed over 60 per cent infection in the Indonesian trials, there is a possibility that this variety is incorrectly designated.

Correlation between Ord and Indonesian results:
Visual comparison suggests that there is a good relationship between Ord and Indonesian results. Phenotypic and genotypic correlation coefficients were calculated between the final Ord plant cane data and the Indonesian plant and ratoon cane data (Table 2). The

results indicate that Ord plant crop versus Indonesian ratoon 1 results give the best correlation. Correlation was between 26 varieties common to each location.

Table 2. Coefficients for phenotypic and genotypic correlations for Ord and Indonesian data.

	Coefficient of Correlation	
	Phenotypic	Genotypic
Ord vs Indonesian plant crop	0.75	0.92+_.07
Ord vs Indonesian ratoon crop	0.86	1.06+_.07

Discussion

Research outcomes

This project has successfully completed preliminary screening of eighty-four cane varieties from the Ord, for susceptibility to sugarcane smut. These results have been used to identify varieties suitable for further assessment in varietal assessment trials. Varieties screened are undergoing further assessment following ratooning of the trial area to confirm the original findings and to allow further comparison with results from Indonesian trials.

Trial procedures were based on those used elsewhere around the world and have been adapted for use under local conditions. The Australian industry has also gained experience in screening for sugarcane smut through trials recently undertaken in Indonesia. This should allow more efficient and successful management of future screening work by the industry.

Comparison was made between results from the Ord and smut trials undertaken in Indonesia by the BSES. Preliminary indications are that Indonesian data can be used to successfully predict smut reactions in the Ord, although further testing would be required to confirm this. The two Indonesian trials examined 26 of the varieties assessed in the Ord. With similar responses at each location, it is possible that in future, ratings could be conducted more efficiently using just one of these sites.

Correlation between ratings of number of stools infected and extent of infection in each plot was generally high. Hence ratings of percentage of infected stools are likely to be a good indicator of extent of infection as well as of impact of smut on crop performance. It was also found that most of the variation amongst means of clone replicates in the trial was due to genetic variation rather than experimental error. This suggests that there would be little loss in ability to discriminate amongst clones by having only 3 replicates in the trial instead of 4.

Resistance/susceptibility ratings

Trials undertaken in the Ord have indicated that later inspections are required to adequately screen varieties for smut. Early inspection of the plant crop identified only a limited number of susceptible varieties. Later inspection results also closely followed field results with commercial canes with resistance in the field, such as Q95, also found to be highly resistant in the trial. Varieties Q117 and NCo310 were highly susceptible in both field and trial situations. Q96 showed more susceptibility in the trial than expected from field results. The higher spore levels and spore pressure in the trial area are likely to have contributed to this result. However, while 32 percent of stools were infected, there were relatively few smut whips per infected stool.

Initial ratoon crop results have shown similarities in smut ratings to the plant crop although with some exceptions. Varieties with higher levels of infection in the plant crop generally expressed symptoms earlier in the ratoon crop. The correlation coefficient between percentage infection at the final plant crop assessment (31 weeks from planting) and the ratoon crop (16 weeks from ratooning) was high at 0.80. In contrast, the correlation between percentage infection at 15 and 31 weeks for the plant crop was much lower at 0.58.

Tentative ratings of the plant crop identified 22 varieties including Q95, Q99, Q130, Q142, and Q155, showing less than 15 percent of infected stools in the final plant crop assessment. These varieties are likely to be sufficiently resistant for commercial production but those at the higher end of the range should be assessed further to confirm this. Q125 was also included in this category but is undergoing DNA testing to confirm its identity since results from Indonesia for Q125 are entirely different from results obtained in the Ord. While many of the varieties identified as smut resistant may ultimately be found unsuitable for production in the Ord based on assessment for other criteria, the smut screening process will continue to be important as the initial assessment as long as significant numbers of introductions continue to be smut susceptible. Inclusion of highly smut susceptible varieties in a varietal assessment trial could influence the assessment of resistant varieties for other selection criteria due to higher than normal spore load in the trial area increasing infection in varieties categorized as resistant.

Since interpretation of results for 'intermediate' canes is more difficult and percent infection can vary depending on factors such as environmental conditions, only preliminary conclusions can be drawn about susceptibility of varieties not clearly either highly resistant or susceptible. Even so, varieties showing over 40 per cent infection are likely to be too susceptible for commercial production and will be discarded. 'Intermediate' varieties with between 15 and 40 percent infection, while also likely to be too susceptible, will undergo further assessment.

Since a significant number of varieties screened were found to be smut susceptible, it is apparent that access to alternative sources of varieties with significant levels of smut resistance will be required in future to ensure adequate numbers of varieties are available for assessment for commercial production. This is likely to include accessing varieties from locations outside Australia where significant selection has already taken place for smut resistance.

Varietal performance:

Canes such as Tellus and Q138 both had around 100 per cent infected stools, but crop, stalk size and type of symptoms were very different, indicating different tolerance to smut. Tellus had masses of thin grassy shoots ranging up to head height with many small whips and few normal stalks. In contrast, most Q138 stalks and stools appeared normal, and the predominant symptoms were the typical looking side shoots induced by smut infection, with many without whips.

Red stripe/top rot infection was heavy throughout the trial probably due to late planting and suitable weather conditions for disease development. Although cane had never been planted on the trial site previously, it was apparent that level of red stripe soil infection was high. It remains unclear as to the extent to which red stripe affected trial results. However, it was found that infection in variety H51-8194, which was severely affected by red stripe in the plant crop, increased from zero percent in the plant crop to over 16 percent at 16 weeks from ratooning.

Conclusions and Industry Impact

The research project has identified a number of areas with potential for inpact on the Australian sugarcane industry:

- The Ord industry will benefit from this research with rapid identification of smut resistant varieties minimizing delays in identifying additional suitable varieties for production in the area. Increasing the number of varieties available for commercial production will assist in improving productivity and profitability as well as minimize the risk associated with potential incursion of other diseases or pests.

- The Australian industry will benefit through provision of essential information that will allow for preparation for potential smut outbreaks in Queensland and NSW. Results from the Ord have confirmed the rapid onset of the disease in the ratoon crop. The extent of infection in the ratoon crop has indicated the potential for loss in productivity of susceptible varieties.

- The industry will also benefit from the development of skills within Australia for screening and management of smut. Techniques have been developed which will allow efficient and effective screening for smut under local conditions.

- The research project has confirmed that most varieties currently available within Australia are smut susceptible.

Future research will need to build on current findings. It is proposed that:

- screening of varieties should continue in the Ord until the suitability of other potential screening sites is proven. Preliminary results from Indonesia indicate that similar results have been obtained from both sites. If adequate correlations could be confirmed then future trials could be conducted at one of these sites only.

- tentative susceptibility/resistance ratings be confirmed for varieties tested in the Ord.

- access to more suitable varieties be investigated. With much of the genetic material available in Australia susceptible to sugarcane smut there is a need to access more suitable material from overseas locations.

Bibliography

Croft, BJ, Irawan and N Berding 2000 Screening Australian Sugarcane Clones for Smut Reaction in Indonesia: Initial Results Proc. Aust. Sugar cane Technol., 22: 170-177.

Hoy, JW 1993 Sugarcane Smut in Louisiana: Biology and Control Bulletin No. 839, April 1993, Louisiana State University Agricultural Centre and Louisiana Agricultural Experiment Station.

Project Technology

Not applicable.

Information Developed

Procedures used in the screening trial were largely adapted from those used in other parts of the world where smut screening occurs. Only minor modifications were made to improve efficiency of operations.

Recommendations on Exploitation of Project Technology

Procedures have been developed for smut screening in the Ord based on technology already available from locations outside Australia. In addition, the BSES is undertaking screening work in Indonesia. The techniques developed in the Ord will continue to be of benefit to the area and would be of benefit should screening be required in Queensland or NSW in the future. Information from the Ord has been made available to the Australian industry through the BSES, CSIRO and through published articles. It is proposed to present a paper on the smut outbreak in the Ord and to include information on the smut screening project, at the 2001 ASSCT conference.

Publications

Engelke J 1999 Clearing the Ord of sugarcane smut. Primary Focus No. 7/1999 Agriculture Western Australia Perth WA

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Engelke J 2000 Clearing the Ord of smut. Australian Sugarcane Annual 2000
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Engelke J 2000 Indonesian smut trial/Ord smut trial. Agricultural MEMO Vol.20. No.1
Agriculture Western Australia Kununurra WA

Engelke J 2000 Smut update. Agricultural MEMO Vol.20. No.2
Agriculture Western Australia Kununurra WA

Engelke J 2000 Sugarcane variety trial results. Agricultural MEMO Vol.20. No.4
Agriculture Western Australia Kununurra WA

In addition:

- Preliminary trial results were presented to Ord growers at a Sugar Research Review held on 29 March 2000.
- A report on results from the final inspection of the plant crop was circulated amongst Ord growers and provided to the BSES for distribution to the Australian industry. The report compares these results with those from the Indonesian trials.
- Field Days were held on 2 December 1999 and 14 September 2000 for the Ord industry to inspect the smut trial and to provide an update on trial progress.

Appendix 1

Ord Smut Trial 1 results showing percentage infected stools for varieties assessed. Values are averaged for 4 replicate trial plots. The trial was planted on 1 September 1999.

	Percentage Infection				
	Plant Crop			Ratoon 1 Crop	
	27 October 1999	13 December 1999	3 April 2000	11 July 2000	6 September 2000
VARIETY					
89-247-5	0.0%	2.5%	4.2%	0.0%	0.0%
89-393-1	0.0%	0.0%	0.0%	0.0%	0.0%
89-393-3	0.0%	0.0%	0.0%	0.0%	0.0%
89-503-10	0.0%	0.0%	41.9%	9.0%	0.0%
89-518-6	0.0%	6.3%	0.0%	0.0%	0.0%
89-680-3	0.0%	7.5%	2.8%	0.0%	0.0%
89-680-6	0.0%	0.0%	0.0%	0.0%	0.0%
H73-6110	0.0%	0.0%	0.0%	0.0%	0.0%
MQ80-805	0.0%	3.1%	0.0%	0.0%	0.0%
MQ88-2022	0.0%	0.0%	0.0%	0.0%	0.0%
MQ88-2047	0.0%	0.0%	8.3%	0.0%	0.0%
Q125	0.0%	0.0%	0.0%	0.0%	0.0%
Q130	0.0%	0.0%	0.0%	3.6%	0.0%
Q155	0.0%	0.0%	0.0%	0.0%	0.0%
Q95	0.0%	0.0%	1.6%	0.0%	0.0%
Q99	0.0%	0.0%	0.0%	0.0%	0.0%
Q142	0.0%	0.0%	0.0%	0.0%	3.1%
90-83-5	0.0%	0.0%	2.8%	0.0%	3.6%
KQ91-31405	0.0%	2.8%	48.4%	2.8%	7.8%
ORPHEUS	0.0%	5.6%	14.6%	0.0%	9.4%
KQ91-31508	0.0%	4.8%	41.7%	7.5%	10.6%
CP74-2005	0.0%	8.3%	12.9%	0.0%	11.1%
Q145	0.0%	5.6%	21.2%	0.0%	14.1%
90-77-5	0.0%	0.0%	16.9%	11.1%	15.7%
H51-8194	0.0%	0.0%	0.0%	0.0%	16.7%
84-608-10	0.0%	2.8%	19.4%	6.3%	18.8%
Q135	0.0%	4.2%	13.1%	10.1%	19.4%
PELORUS	0.0%	0.0%	44.2%	3.6%	20.5%
Q96	0.0%	0.0%	31.8%	14.2%	24.9%
Q124	0.0%	8.0%	41.7%	11.5%	30.4%
Q101	0.0%	7.7%	10.4%	15.0%	34.4%
Q120	0.0%	11.3%	40.0%	8.3%	37.5%
Q161	0.0%	24.7%	30.9%	0.0%	44.0%
H78-7234	0.0%	3.1%	62.2%	42.7%	52.3%
Q107	0.0%	5.6%	18.5%	19.0%	52.5%
MQ79-141	0.0%	22.8%	57.0%	68.1%	57.6%
Q150	0.0%	11.9%	90.8%	6.7%	58.3%
90-110-9	0.0%	22.2%	41.7%	30.2%	61.3%
MQ87-540	0.0%	5.0%	27.8%	28.3%	63.6%
MQ87-155	0.0%	0.0%	38.2%	12.5%	63.9%
ROC-1	2.8%	38.7%	61.7%	55.3%	66.7%

KQ88-8075	8.2%	18.1%	75.4%	40.6%	70.2%
Q137	0.0%	46.2%	78.1%	36.3%	71.9%
84-608-3	0.0%	15.0%	34.7%	14.7%	72.2%
88-402-2	0.0%	13.1%	70.8%	45.8%	72.2%
Q113	2.3%	28.6%	40.3%	33.0%	72.2%
87-105-10	0.0%	5.3%	43.3%	0.0%	72.9%
84-608-6	0.0%	30.0%	75.0%	14.6%	75.0%
BMQ89-77	0.0%	35.6%	100.0%	70.8%	75.0%
Q162	0.0%	6.3%	85.4%	84.8%	75.0%
Q138	0.0%	18.5%	100.0%	13.1%	75.6%
BMQ89-14	0.0%	7.5%	78.1%	36.5%	76.0%
BMQ89-15	0.0%	5.3%	78.3%	55.1%	77.0%
89-605-1	2.5%	12.8%	33.0%	52.3%	81.4%
KQ87-7339	0.0%	74.6%	100.0%	80.6%	84.4%
NCO310	0.0%	16.0%	58.8%	42.3%	86.3%
Q164	0.0%	11.7%	61.5%	54.3%	86.9%
MQ63-693	0.0%	3.1%	40.1%	30.5%	88.1%
Q121	0.0%	9.1%	71.4%	30.6%	88.9%
Q154	0.0%	13.1%	96.4%	82.6%	90.0%
Q115	0.0%	22.9%	64.0%	44.8%	90.9%
TS68-830	0.0%	16.4%	60.7%	61.4%	91.0%
Tellus	0.0%	81.6%	97.2%	81.6%	91.7%
MQ84-524	2.5%	10.3%	97.2%	61.4%	91.9%
84-255-4	0.0%	28.7%	100.0%	91.7%	93.1%
MQ74-110	2.5%	25.2%	100.0%	62.9%	93.8%
Q117	0.0%	19.2%	91.3%	90.6%	93.8%
90-77-2	0.0%	41.8%	56.3%	37.7%	94.7%
MQ87-1069	0.0%	54.6%	100.0%	77.4%	97.2%
84-255-10	0.0%	24.2%	96.9%	86.7%	100.0%
86-1151-3	3.6%	44.8%	94.4%	56.8%	100.0%
87-628-3	0.0%	10.4%	49.6%	80.9%	100.0%
88-271-6	2.5%	55.3%	97.5%	58.4%	100.0%
89-338-1	19.0%	75.1%	100.0%	100.0%	100.0%
89-503-6	2.5%	2.5%	86.1%	61.7%	100.0%
BMQ89-338	0.0%	22.8%	56.9%	49.8%	100.0%
EOS	2.1%	57.6%	100.0%	92.5%	100.0%
KQ91-1003	0.0%	16.1%	92.3%	57.5%	100.0%
Q122	3.8%	25.4%	100.0%	86.8%	100.0%
Q127	0.0%	29.5%	100.0%	89.2%	100.0%
Q157	7.3%	53.3%	100.0%	91.9%	100.0%
Q158	12.0%	63.8%	100.0%	60.6%	100.0%
Q159	2.1%	5.0%	100.0%	73.8%	100.0%
Q91	0.0%	5.6%	96.4%	90.9%	100.0%